Impact of High and Low Forage Diets on Dairy Farms

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Introduction

Dairy farms are complex systems with many components to manage. These components include crop production, harvest, storage, feeding, milk production and handling, manure management, tillage, and planting. Many of these components interact with weather and each other, so a change in one part of the farm may cause changes throughout other farm components. For example, a change in rations will affect the nutrient content of manure which can affect the fertilizer requirement and the productivity of future crops. In recent years with relatively low grain prices, dairy farmers have fed more grain than necessary with just enough forage to maintain proper rumen function. With the recent increase in grain prices, there is an opportunity to improve profitability by utilizing more forage and less grain in the dairy diet.

Materials and Methods

The long term performance and benefits of alternative dairy forage systems are best compared using DAFOSYM. DAFOSYM is a simulation model which integrates the many biological and mechanical processes on a dairy farm. Crop production, feed use, and the return of manure nutrients to the land are simulated over many years of weather. Simulated performance is used to predict the costs, income, and net returns or profit for typical dairy farms. By modeling several alternatives for the same base farm, those that provide maximum farm production or profit with good labor utilization and minimal effect on the environment are determined. All production and economic information is determined for each simulated year of weather. The distribution of annual values obtained can then be used to assess the risk involved in alternative technologies or strategies as weather conditions vary. The model was used to compare the whole-farm impacts of using high grain or high forage diets.

The modeled farm represented a typical 100-cow dairy farm in southern Michigan with 250 acres of owned land. The soil was a loam of medium depth. Essentially all forage and grain feeds required by the herd were produced on the farm using various portions of alfalfa and corn. Alfalfa was harvested using a four cutting harvest strategy with the first two cuttings harvested at a bud stage of development and the last two harvested in early bloom. Harvests began within 5 days of May 30, July 6, and August 20 for the first three cuttings and on October 15 for the fourth cutting. All cuttings were harvested as wilted silage.

Alfalfa was grown in a four year rotation with corn. Corn was harvested as silage and high moisture grain to fill the available silos, and additional corn was harvested as dried grain. Over the 25-year simulation, post harvest crop yields ranged from 4.0 to 5.7 ton DM/acre for alfalfa with a mean of 5.0 ton DM/acre. For corn silage, the range was 4.6 to 8.6 ton DM/acre with a mean of 6.1 ton DM/acre, and for corn grain the range was 75 to 155 bushel/acre for an average of 108 bushel/acre.

The herd included 100 Holstein animals (milking and dry) plus 85 replacement stock. Analyses were done with annual milk production set at 20,000 lb/cow. Feed rations were determined for two groups of heifers, a dry cow group, and three groups of lactating animals. A mobile mixing wagon was used to prepare total mixed rations (TMR) for each animal group. Cows were housed in a free stall barn and milked in a double six parlor. The culling rate of the herd was 35% which set the number of first-lactation animals at 35.

Simulations were conducted for two amounts of forage in lactating animal diets. First, a high forage diet was used where about 60% of the dry matter in lactating cow rations came from forage. Next, a high grain diet was assumed where forage was about 45% of the ration dry matter. The alfalfa area was reduced and the corn area was increased according to the feed needs. Simulations were done for 25 weather years using East Lansing, Michigan weather data. Prices were set to reflect long-term relative values of farm inputs and outputs in current dollars.

Results and Discussion

Simulated measures of farm performance included the feeds produced, those bought and sold to meet the needs of the herd, the milk production of the herd, and the manure produced and handled. The economic results included all major costs incurred and income from milk, excess feed, and animal sales. The net return to management was the difference between income and costs and thus provided an indication of farm profit.

With a shift from high grain to high forage diets, the need for forage increased. Alfalfa land was increased from 145 acres to 190 acres, and corn land was decreased from 105 acres to 60 acres. Alfalfa silage production increased from 600 ton DM to 800 ton DM while corn grain production dropped from 250 ton DM to 140 ton DM. With the use of more alfalfa, the soybean meal required to meet protein requirements dropped by about 10 ton DM per year. Due to the lower digestibility of high forage diets, manure production increased about 13%. With more alfalfa and less corn on the farm, the ratio of nitrogen available to that required to produce the corn increased from 2.7 to 5.6 while the farm maintained a good balance of phosphorus and potassium. This meant that much of the manure had to be applied to alfalfa to absorb the excess nitrogen.

Use of a high forage diet caused a slight decrease in purchased feed costs. This was due primarily to a need for less protein supplement when more alfalfa was fed. Because corn grain was custom harvested, the use of less grain reduced harvest costs. Fertilizer, chemical and drying costs also decreased with less corn on the farm. With all factors considered, the net return for the farm increased about $3,900 per year through the use of the high forage diet compared with the high grain scenario.

Conclusion

With rising grain prices, an obvious consideration is to use more forage and less grain in dairy rations. For farms where much of the grain is purchased from off-farm sources, there is a clear economic advantage for buying less corn. On farms where most of the feeds are produced on the farm, the advantage still exists, but it is not as great. When feeds are produced and used on the farm, the cost of production is much more important than the market price or value of those feeds. Use of more alfalfa forage can lead to considerable excess nitrogen on the farm which requires much of the manure to be applied to alfalfa to avoid loss of nitrogen to the environment.